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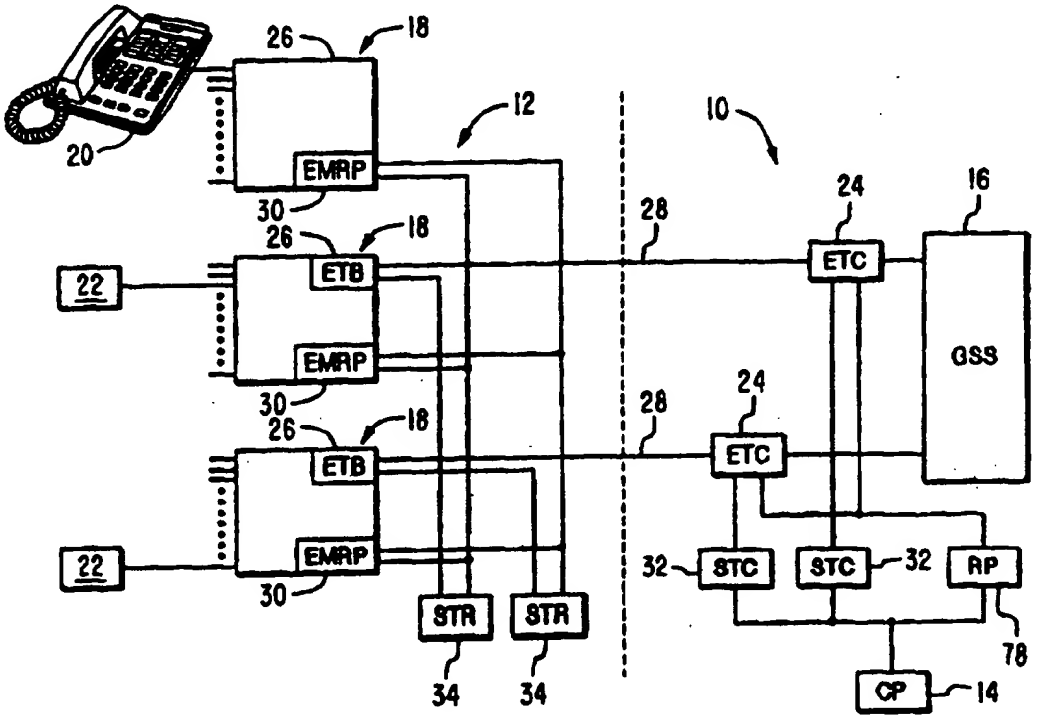
(54) Title: METHOD AND APPARATUS FOR MEASURING LOADS IN A COMMON CHANNEL SIGNALLING LINK

(57) Abstract

A method and apparatus for monitoring the load on a communications link (28) in a common channel signalling system connecting an exchange (10) in a telephone network to regional equipment such as a remote subscriber switch (12) or a remote cellular base station (64). The length indicator field (54) of each signal unit (36, 38, 40) transmitted over the reserved channel of the communications link is monitored (82) by the exchange to determine the number of bytes of message data being transmitted over the link during a predetermined time period. The load on the communications link is identified by taking the ratio (92) of the determined number of bytes (88) to the number of full value bytes (90) capable of transmission over the communications link during an identical time period. The determined load ratio is compared (98) to a predetermined threshold level to identify an overload condition in response to which the exchange relieves the overload (100) by spreading the messages to other links, discarding low priority ones of the messages, or controlling message flow over the link as necessary.



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METHOD AND APPARATUS FOR MEASURING LOADS IN A COMMON CHANNEL SIGNALLING LINK

BACKGROUND OF THE INVENTION

Technical Field of the Invention

The present invention relates to telephone networks and, in particular, to the common channel signalling links provided therein, and to the measurement of the message loads present on such signalling links.

Description of Related Art

Telephone networks utilize common channel signalling to facilitate message communications between the central processor in a parent exchange and the processors in any included regional equipment external to the exchange. Common channel signalling occurs over at least one of the communications links that also carry subscriber voice communications. At least one channel on at least one of the communications links is reserved for providing a two-way signalling path between the central processor and each of the regional equipment processors. A signalling terminal located at each end of the communications link functions to format processor signalling messages for transmission over the reserved channel, and further provides any other transfer control, maintenance or restart functions necessary for interfacing the link with the exchange and the regional equipment.

The processor signalling messages transmitted over the reserved channel of the communications link are formatted in accordance with the CCITT Common Channel Signalling System No. 7 level 2 protocol. These message transmissions comprise digital signals transmitted at a rate of 64 kbps. Analog message signals may also be transmitted in a common channel signalling system using the format defined by the CCITT Common Channel Signalling System No. 6 protocol at a rate of 2.4 kbps.

As the functional capabilities of telephone exchanges have improved to provide more and more services to

subscribers, including the addition of so-called value added services, the demands placed on the reserved channel of the communications link in a common channel signalling system and the competition for access to and use of the communications link have increased dramatically. This is especially a concern in mobile telephone networks where the transmission capabilities of the communications links between the mobile service switching center of the exchange and the remote base stations which communicate with the cellular telephones dictate the number of signalling/transmission messages that may be handled by the network. Loading of the communications link, and in particular the common channel signalling system, adversely affects the nature and quality of the services provided to the subscribers. Accordingly, it has become increasingly important to monitor and identify in a graceful and progressive manner, and in real time, the load of useful traffic being serviced by the reserved channel on the communications link in a common channel signalling system.

SUMMARY OF THE INVENTION

Messages transmitted over the communications link using the CCITT CCS # 7 protocol are conveyed by means of a signal unit. Signal units are of varying length (up to a predetermined limit), with the length used determined by the amount of signalling information included in the message. There are several types of signal units authorized by the CCITT CCS # 7 protocol including the following three types: a Message Signal Unit (MSU); a Link Status Signal Unit (LSSU); and a Fill-In Signal Unit (FISU).

Each signal unit includes the same transfer control fields for providing signal unit delimitation, sequencing, error control, and type discrimination. The signal units further each include a length indicator field which identifies the number of 8-bit message carrying bytes that

are included in the signal unit between the length indicator field and a subsequent check bit field. The length indicator field accounts for the presence of, and therefore does not include in the field value the number of fill-in bytes, if any, present in the signal unit.

In accordance with the method and apparatus of the present invention, the communications link is monitored by the exchange on a continuous basis, with each such monitoring instance occurring for a predetermined time period. In particular, the length indicator field of each signal unit carried over the communications link is monitored by the exchange during the predetermined time period to identify in real time the number of bits of "useful" (i.e., message) traffic passing over the communications link. This information is advantageously provided to the exchange by reading the length indicator field of each signal unit transmitted over the link.

Rather than use the value of the length indicator field to identify the type of signal unit (as has historically been the case), in the present invention the values (in numbers of bits) of useful signal unit traffic identified from reading the length indicator fields of each signal unit are summed over the time period and compared to a total value (in numbers of bytes) for the maximum data load capable of being carried by the control signalling link during an identical time period. From this information, the load on the communications link is determined and further processed by the exchange to optimize exchange signalling by different means, such as by spreading the communications traffic (and in particular the message traffic) over each of the included communications links, discarding certain messages, or limiting message flow.

BRIEF DESCRIPTION OF THE DRAWINGS

A more complete understanding of the method and apparatus of the present invention may be had by reference

to the following Detailed Description when taken in conjunction with the accompanying Drawings wherein:

FIGURE 1 is a block diagram of a portion of a telephone network utilizing a common channel signalling system;

FIGURE 2 is a block diagram of a portion of a mobile telephone network utilizing a common channel signalling system;

FIGURES 3-5 illustrate the messaging formats for the three types of signal units as specified by the CCITT Common Channel Signalling System No. 7 level 2 protocol; and

FIGURE 6 is a flow diagram showing the processing method of the present invention.

DETAILED DESCRIPTION OF EMBODIMENTS

The functional operation and configuration of exchanges and regional equipment in telephone networks are well known to those skilled in the art. To facilitate an understanding of the present invention, a brief description of the elements of and interconnections within an exchange and some exemplary pieces of regional equipment (comprising a remote subscriber switch and a remote base station) will be provided herein.

Referring now to FIGURE 1, there is shown a block diagram of a portion of a telephone network including a parent exchange 10 and a piece of regional equipment comprising a remote subscriber switch 12. It will, of course, be understood that the present invention is useful with many different regional equipment types, and the disclosure of the connection of a remote subscriber switch 12 to the exchange 10 in FIGURE 1 is by way of illustration of the application of the invention rather than of limitation.

The parent exchange 10 includes a central processor 14 and a group switching subsystem 16. The parent exchange 10 further includes a plurality of exchange terminal circuits 24 connected to the group switching subsystem 16. The remote subscriber switch 12 includes a plurality of line switch modules 18, each of which may be connected to a plurality of subscriber telephones 20, and/or to a plurality of any other type of compatible subscriber communication devices 22. Each line switch module 18 in the remote subscriber switch 12 includes an exchange terminal board 26.

A communications link 28 is provided to connect each exchange terminal board 26 to a corresponding exchange terminal circuit 24 in the parent exchange 10. It will, of course, be understood that each communications link 28 is time division multiplexed to provide a plurality of channels for carrying subscriber voice communications between the parent exchange 10 and the remote subscriber

switch 12. In E-1 (European) practice, thirty-two channels are provided. In T-1 (North American) practice, twenty-four channels are provided.

In order for the telephone network to operate properly, the parent exchange 10 and the remote subscriber switch 12 must be able to communicate with each other. In particular, it is vitally important that the central processor 14 of the exchange 10 be able to communicate with an extension module regional processor 30 present in each line switch module 18. Because it would be too costly to provide a separate physical communications link between the central processor 14 and each extension module regional processor 30, one of the plurality of subscriber channels provided on the communications link 28 is assigned to carry processor signalling messages.

In E-1 practice, channel sixteen and, in T-1 practice, channel nine on the communications link 28 are reserved for carrying processor signalling messages. It will be understood, however, that any one or more than one of the plurality of channels may be reserved for this task. The use of one or more of the subscriber channels reserved for carrying processor signalling message communications is referred to in the art as "common channel signalling." In order to provide for improved system reliability, at least two separate communications links 28 between the exchange 10 and the remote subscriber switch 12 have a channel reserved thereon for carrying processor signalling message communications.

A signalling terminal (central) 32 is provided in the exchange 10 to connect the central processor 14 to each of the exchange terminal circuits 24. One signalling terminal (central) 32 is provided for each communications link 28 extending between the exchange 10 and the remote subscriber switch 12 that is to be used by the network for common channel carrying of processor signalling message communications. The signalling terminal (central) 32 processes and formats processor signalling messages output

from the central processor 14 into the proper format for transmission over the communications link 28. The exchange terminal circuit 24 then inserts the formatted messages through time division multiplexing into the reserved channel of the communications link 28 for transmission thereover to the remote subscriber switch 12.

In the remote subscriber switch 12, a signalling terminal (remote) 34 is provided to connect each extension module regional processor 30 to the exchange terminal boards 26. The exchange terminal board 26 extracts the formatted processor signalling messages from the reserved channel of the communications link 28, and the connected signalling terminal (remote) 34 processes and reformats the processor signalling messages for output to the extension module regional processor 30.

It will, of course, be understood that processor signalling messages may also be transmitted in the opposite direction from the extension module regional processor 30 to the central processor 14. These messages may comprise both original messages generated by the extension module regional processor 30 and responses to messages transmitted by the central processor 14. In either case, the signalling terminal (remote) 34 and the signalling terminal (central) 32, and the exchange terminal board 26 and exchange terminal circuit 24, perform the functions opposite from that described above with respect to the formatting and reformatting the processor signalling messages for transmission over, and the inserting and extracting of the processor signalling messages into and from the communications link 28.

The format of the processor signalling messages transmitted over the communications link 28 is based on the CCITT Common Channel Signalling System No. 7 level 2 protocol. With reference now to FIGURES 3-5, there are several types of signal units authorized by the CCITT CCS # 7 protocol for use on the communications link 28 including the following three types: a Message Signal Unit

(MSU) 36; a Link Status Signal Unit (LSSU) 38; and a Fill-In Signal Unit (FISU) 40. The MSU 36 is used to communicate signal messages between the components of the exchange and the remote subscriber switch 12. The LSSU 38 is used to communicate status information concerning the communications link 28. This information may relate to, for example, the initialization of the link 28. The FISU 40 is used to fill-in space on the reserved channel of the communications link 28 when no MSUs 36 or LSSUs 38 are being transmitted.

The MSU 36, LSSU 38 and FISU 40 are each delimited by an opening and closing Flag (F) 42 and 44, respectively. The opening flag 42 is sequentially followed by a Backward Sequence Number (BSN) field 46, a Backward Indicator Bit (BIB) 48, a Forward Sequence Number (FSN) field 50, and a Forward Indicator Bit (FIB) 52. In an MSU 36, the FSN field 50 records the sequence number assigned to the signal unit. In an LSSU 38 and FISU 40, the FSN field 50 contains the sequence number of the most recently sent MSU 36. The BSN field 46 is used to acknowledge the receipt of the signal unit. The BIB 48 and FIB 52 are used in conjunction with the associated BSN field 46 and FSN field 50, respectively, to provide for error correction capability. These bits are also used to initiate retransmission of a signal unit.

Each of the signal units 36, 38 and 40 further includes a Length Indicator (LI) field 54 which contains a value indicating the number of useful or message 8-bit bytes included in the signal unit between the LI field and an included Check Bit (CK) field 56. The total number of bytes transmitted between the LI field 54 and CK field 56 comprise not only the bytes associated with the processor signalling message, if any, being transmitted, but also other information bytes and/or fill-in bytes as will be described herein. The CK field 56 includes data used for detecting transmission errors affecting the content of the signal unit.

When a signal unit is received at the signalling terminals 32 and 34, a hardware interrupt of processor (12 or 30) operation is triggered resulting in a diminishment of processor load. To reduce the frequency of unnecessary interrupts caused by the receipt of LSSUs 38 and FISUs 40, and thus improve processor load, extra bytes referred to as "fill-in" bytes 57 are inserted into the LSSUs and FISUs between the LI field 54 and CK field 56. The number of fill-in bytes 57, if any, used varies with the linkspeed of the network. The LI field 54 accounts for the presence of, and therefore does not include in the field value, the number of any fill-in bytes 57 present in the signal unit.

The LI field 54 has conventionally only been used to identify the type of signal unit being transmitted. For example, only an MSU 36 (FIGURE 3) will have an LI field value greater than or equal to three. Furthermore, only an LSSU 38 (FIGURE 4) will have an LI field value equal to either one or two. Finally, only an FISU 40 (FIGURE 5) will have an LI field value equal to zero. As will be described in more detail herein, the value of the length indicator field is advantageously used by the present invention in the determination of the load being carried by the common channel signalling link.

Because only MSUs 36 have LI field values greater than or equal to three, this means that at least three bytes of signalling (i.e., message) data are included between the LI field 54 and CK field 56. These three bytes include not only the processor signalling message 59 itself, but also the bytes provided in a Service Indicator (SI) field 58 and a Signalling Information Field (SIF) 60. The SI field 58 carries information about the priority of the MSU 36. The SIF 60 contains signalling information. Fill-in bytes 57 may also be present, but are not counted in determining the LI field 54 value.

The LSSU 38 has an LI field value equal to either one or two, meaning that either one or two bytes of signalling

(i.e., message) data are included between the LI field 54 and CK field 56. These one or two bytes include not only the processor signalling message 59 itself, if any is present, but also the byte provided in a Status inFormation (SF) field 62. The SF field 62 carries information relating to the status of the communications link 28. Fill-in bytes 57 may also be present, but are not counted in determining the LI field 54 value.

Finally, the FISU 40 has an LI field value equal to zero, meaning that zero bytes of processor signalling (i.e., message) data are included between the LI field 54 and CK field 56. Fill-in bytes 57 may be present, but are not counted in determining the LI field 54 value. The FISU is only used on the communications link 28 when no MSUs 36 or LSSUs 38 are being transmitted.

Referring now to FIGURE 2, wherein like or similar elements in the telephone network are designated with the same reference numeral as in FIGURE 1, there is shown a block diagram of a portion of a mobile telephone network including an exchange 10' and a remote base station 64. The exchange 10' includes a central processor 14, a group switching subsystem 16, exchange terminal circuits 24 and signalling terminals (central) 32 interconnected in the same manner as provided in the parent exchange 10 of FIGURE 1.

In the remote base station 64, the communications links 28 with the exchange 10' are connected to a multiplexer 66. The multiplexer 66 performs a similar function to the exchange terminal board 26 in the remote subscriber switch 12 of FIGURE 1. The processor signalling messages carried on the channels (e.g., channel sixteen) in each communications link 28 for the common channel signalling system are connected to a signalling terminal (regional) 34 which is further connected to the extension module regional processor 30.

The subscriber communications carried on the channels of the communications link 28, on the other hand, are

connected from the multiplexer 66 to a plurality of voice channel circuits 68 for facilitating subscriber communications over a wireless communications link 70 using mobile telephones 72. The extension module regional processor 30 is also connected to the voice channel circuits 68, and is further connected to a control channel circuit 74 for facilitating the use of well known control message communications over the link 70 between the base station 64 and the mobile telephones 72. A signal strength circuit 76, also connected to the extension module regional processor 30, is provided for monitoring the signal strength of the communications effectuated over the link 70 between the base station 64 and the mobile telephones 72.

In the mobile telephone network of FIGURE 2, the processor signalling messages are formatted and reformatted for transmission over, and inserted into and extracted from the communications link 28 in the same manner as provided for and described above with respect to the common channel signalling system for the telephone network of FIGURE 1. As previously described, these processor signalling messages are formatted into signal units (MSUs 36, LSSUs 38 and FISUs 40) in accordance with the CCITT CCS # 7 protocol.

The capacity of the networks of FIGURES 1 and 2 for handling subscriber communications is related to the capacity of the channel of the communications link 28 reserved for carrying processor signalling messages in a common channel signalling system. Attention to common channel signalling system capacity issues has become even more important of late as the capabilities of, and the services provided by telephone network exchanges have dramatically increased. If the reserved channel on the communications link 28 carrying processor signalling messages on a common channel signalling system becomes overloaded, it becomes increasingly more difficult for the system to handle voice communications and for the

subscriber to make efficient and effective use of any exchange provided services and, in particular, value added services. Accordingly, it is vitally important that the processor signalling message load on the communications link 28 be closely monitored in a graceful, proactive manner, rather than on a reactive manner as has historically been the case.

Reference is now again made to FIGURES 1 and 2 described above, and additionally to FIGURE 6 wherein there is shown a flow diagram illustrating the processing method of the present invention. Through use of the central processor 14 of the exchanges 10 or 10', or preferably any other regional processor 78 included therein, the exchange monitors processor signalling message traffic over the communications link 28 (step 80 of FIGURE 6) on the common channel signalling system. In particular, the regional processor monitors the LI field 54 of each signal unit (MSU 36, LSSU 38 or FISU 40) transmitted over the communications link 28 during a predetermined time period to identify the LI field values providing the number of 8-bit bytes of useful message traffic (i.e., the relevant bytes included in the signal unit between the LI field and the CK field 56) in each signal unit (step 82 of FIGURE 6). In the preferred embodiment, the predetermined time period is selected to be one second. The determination of the number of relevant 8-bit bytes transmitted over the reserved channel is made by summing the monitored LI field 54 values for the signal units transmitted over the link 28 during the one second time period (step 84 of FIGURE 6).

The number of bytes identified in step 82 is next compared to the number of full frame CCITT CCS # 7 protocol bytes that could be transmitted over the communications link 28 (step 86 of FIGURE 6). In particular, the summed LI field 54 values for the time period are multiplied by eight and added to fifty-six to determine the total number of bits of relevant message

data transmitted over the communications link 28 during the time period (step 88 of FIGURE 6). To identify the load on the communications link 28 caused by the transmission of processor signalling messages, the ratio of the number of bits found in step 88 to the maximum number of CCITT CCS # 7 protocol bits transmittable in one second is taken (step 90 of FIGURE 6). For a 64 kbps facility, 64,000 bits of full frame CCITT CCS # 7 protocol data is the maximum number of bits that could be transmitted in a one second time period. This ratio figure can be converted to a loading ratio percentage by multiplying by one hundred (step 92 of FIGURE 6). The equation for calculating the loading ratio in percent is given by the following:

$$LOADINGRATIO(\%) = \frac{\sum_{i=1}^{m} (LIx8) + 56}{64,000} x100$$

wherein m is the total number of signal units transmitted in one second, and LI is the LI field 54 value of the MSUs 36, LSSUs 38 and FISUs 40 transmitted over the communications link. It will be noted that for transmitted FISUs 40, the LI field 54 value is zero and therefore does not contribute to the total number of transmitted bits of relevant message data. The load calculation is repeated for the common channel signalling systems provided on each communications link 28 (step 94 of FIGURE 6).

The regional processors 78 of the exchanges 10 and 10' monitor the communications link 28 through the provided signalling terminals (central) 32 and/or the exchange terminal circuits 24 and, in response to the determined loading ratio, control operation of and access to the communications links 28 provided between the exchange and the included regional equipment such as the remote subscriber switch 12 or remote base station 64

(step 96 of FIGURE 6). The determined loading ratio is compared to a predetermined threshold level which may be adjusted (step 98 of FIGURE 6) to gracefully and proactively detect the existence of an overloading condition, in response to which the processors 14 or 78 of the exchanges 10 or 10' will operate to relieve the overloading condition (step 100 of FIGURE 6) by, for example, spreading the processor signalling messages across more of the included communications links 28 in the network, and thus increase the number of messages per second that the network is currently handling. The processors 14 or 78 alternatively may respond to an overloading condition by discarding low priority messages or controlling the flow of signalling terminal traffic.

Although a preferred embodiment of the method and apparatus of the present invention has been illustrated in the accompanying Drawings and described in the foregoing Detailed Description, it will be understood that the invention is not limited to the embodiment disclosed, but is capable of numerous rearrangements, modifications and substitutions without departing from the spirit of the invention as set forth and defined by the following claims.

WHAT IS CLAIMED IS:

1. A telephone system, comprising:

an exchange including a central processor;

a piece of regional equipment including at least one regional processor;

a communications link connecting the exchange to the piece of regional equipment, the communications link comprising multiple time division multiplexed channels, at least one of said channels being a signalling channel carrying common channel signalling messages between the central processor of the exchange and the at least one regional processor in the regional equipment;

means in the exchange for monitoring the communications load on each signalling channel carrying common channel signalling messages to detect an overloading of the signalling channel on the communications link; and

means in the exchange responsive to the overloading of any reserved channel for relieving the overloading.

2. The telephone system as in claim 1 wherein the means for relieving comprises means for spreading the common channel signalling messages to other communications links.

3. The telephone system as in claim 1 wherein the means for relieving comprises means for discarding certain ones of the common channel signalling messages as being of a low priority.

4. The telephone system as in claim 1 wherein the means for relieving comprises means for controlling flow of common channel signalling messages.

5. The telephone system as in claim 1 wherein the means for monitoring comprises:

means for determining a loading ratio for the common channel signalling communications transmitted over each signalling channel in the communications link; and

means for comparing the determined loading ratio to an adjustable threshold value to detect the overloading of the communications link.

6. The telephone system as in claim 5 wherein the common channel signalling messages are formatted into signal units, and the means for determining comprises:

means for monitoring a processor message portion in each signal unit;

means for summing the amount of message data in the processor message portions of signal units transmitted over the communications link during a predetermined time period;

means for taking the ratio of the summed amount of message data to an amount of full frame data transmittable over the communications link during an equivalent time period.

7. The telephone system as in claim 6 wherein each signal unit includes a length indicator field containing a value indicative of the number of bytes of message data carried by the signal unit, the means for monitoring comprising means for reading the length indicator field of each signal unit transmitted over the signalling channel of the communications link, the read value being indicative of the amount of message data.

8. In a telephone system utilizing common channel signalling to handle signal unit messages transmitted over a signalling channel of a time division multiplexed communications link between a first and a second processor, a method for communications link load determination comprising the steps of:

monitoring the amount of message data in each signal unit transmitted over the signalling channel during a predetermined time period;

summing the monitored amount of message data to identify a total amount of message data transmitted over the signalling channel during the predetermined time period;

comparing the summed total amount of message data with an amount of full frame data transmittable over the signalling channel during an equivalent time period to obtain a loading ratio for the communications link;

comparing the loading ratio with a threshold loading value to determine the existence of an overload condition; and

relieving overload on the communications link following determination of the existence of the overload condition.

9. The method as in claim 8 wherein the step of relieving includes one or more of the following steps of spreading signal unit messages to other communications links, discarding low priority signal unit messages or controlling flow of signal unit messages.

10. The method as in claim 8 wherein each signal unit includes a length indicator field containing a value related to the amount of message data being transmitted by the signal unit, the step of monitoring comprising the step of reading the value in the length indicator field of each signal unit.

11. The method as in claim 10 wherein the step of summing comprises the step of adding together the read length indicator field values.

12. A common channel signalling system, comprising:

a communications link having multiple time division multiplexed channels, at least one channel being a signalling channel carrying signalling messages in the form of signal units, each signal unit including message data;

means at each end of the communications link for inserting the signal units into and extracting the signal units from the signalling channel of the communications link; and

means for monitoring the load on the communications link, comprising:

means for determining a total amount of message data carried by signal units over the signalling channel of the communications link during a predetermined time period; and

means for comparing the determined total amount with an amount of full frame data transmittable over the signalling channel of the communications link during an equivalent time period to identify a loading ratio for the communications link.

13. The common channel signalling system as in claim 12 further including means responsive to the identified loading ratio for identifying an overload on the communications link and in response thereto relieving the overload.

14. The common channel signalling system as in claim 13 wherein the means for identifying and relieving comprises means for spreading the signalling message transmissions to other communications links in response to the overload.

15. The common channel signalling system as in claim 13 wherein the means for identifying and relieving comprises means for discarding certain ones of the

signalling message transmissions as being of a low priority.

16. The common channel signalling system as in claim 13 wherein the means for identifying and relieving comprises means for controlling flow of messages through the means for inserting and extracting.

17. The common channel signalling system as in claim 12 wherein the means for determining comprises:

means for reading the value in a length indicator field in each signal unit; and

means for summing the values read during the predetermined time period to determine the total amount of message data carried over the communications link.

18. The common channel signalling system as in claim 12 wherein the means for comparing comprises means for taking the ratio of the determined total amount of message data to the amount of full frame data.

19. In a common channel signalling system including a time division multiplexed communications link having multiple channels, at least one channel being a signalling channel carrying signalling messages in the form of signal units, each signal unit including message data, a method for monitoring the load on the communications link comprising the steps of:

determining a total amount of message data carried by signal units over the signalling channel of the communications link during a predetermined time period; and

comparing the determined total amount with an amount of full frame data transmittable over the signalling channel of the communications link during an equivalent time period to identify a loading ratio for the communications link.

20. The method as in claim 19 further including the steps of:

identifying an overload on the communications link from the loading ratio; and in response thereto either

spreading the signalling message transmissions to other communications links in the response to the overload;

discarding low priority ones of the signalling message transmissions; or

controlling the flow of signalling messages over the communications link.

21. The method as in claim 19 wherein the step of determining comprises the steps of:

reading the value in a length indicator field in each signal unit transmitted over the communications link; and

summing the values read during the predetermined time period to determine the total amount of message data carried over the communications link.

22. The method as in claim 19 wherein the step of comparing comprises the step of taking the ratio of the determined total amount of message data to the amount of full frame data.

23. A telephone system, comprising:

an exchange including a central processor;

a piece of regional equipment including at least one regional processor;

a communications link connecting the exchange to the piece of regional equipment, the communications link comprising multiple time division multiplexed channels, at least one of said channels being a signalling channel carrying common channel signalling messages between the central processor of the exchange and the at least one regional processor in the regional equipment;

means in the exchange for monitoring the communications load on each signalling channel carrying common channel signalling messages to measure real-time loading of the signalling channel on the communications link; and

means in the exchange responsive to an increase in the measured real-time loading of the signalling channel indicative of a danger of overload for relieving the increasing loading.

24. The telephone system as in claim 23 wherein the means for relieving comprises one or more of the following:

means for spreading the common channel signalling messages to other communications links;

means for discarding certain ones of the common channel signalling messages as being of a low priority; or

means for controlling flow of common channel signalling messages.

25. The telephone system as in claim 23 wherein the means for monitoring comprises:

means for determining a loading ratio for the common channel signalling communications transmitted over each signalling channel in the communications link; and

means for comparing the determined loading ratio to an adjustable threshold value to detect the increasing loading of the communications link.

26. The telephone system as in claim 25 wherein the common channel signalling messages are formatted into signal units, and the means for determining comprises:

means for monitoring a processor message portion in each signal unit;

means for summing the amount of message data in the processor message portions of signal units transmitted over the communications link during a predetermined time period; and

means for taking the ratio of the summed amount of message data to an amount of full frame data transmittable over the communications link during an equivalent time period.

27. The telephone system as in claim 26 wherein each signal unit includes a length indicator field containing a value indicative of the number of bytes of message data carried by the signal unit, the means for monitoring comprising means for reading the length indicator field of each signal unit transmitted over the communications

link, the read value being indicative of the amount of message data.

28. The common channel signalling system as in claim 12 further including means responsive to increases in the identified loading ratio for identifying a danger of overload on the communications link.

29. The common channel signalling system as in claim 28 further including means responsive to dangerous increases in the identified loading ratio for relieving loading increases.

30. The common channel signalling system as in claim 29 wherein the means for relieving comprises one of the following:

means for spreading the signalling message transmissions to other communications links in response to the overload;

means for discarding certain ones of the signalling message transmissions as being of a low priority; or

means for controlling flow of messages through the means for inserting and extracting.

31. The method as in claim 19 further including the step of identifying from the loading ratio increases in the load on the communications link indicative of a danger of overload.

32. The method as in claim 31 further including the steps of responding to dangerous increases by either:

spreading the signalling message transmissions to other communications links in the response to the overload;

discarding low priority ones of the signalling message transmissions; or

controlling the flow of signalling messages over the communications link.

33. In a telephone system utilizing common channel signalling to handle signal unit messages transmitted over a signalling channel of a multi-channel time division multiplexed communications link between a first and a second processor, a method for communications link load determination comprising the steps of:

monitoring the amount of message data in each signal unit transmitted over the signalling channel during a predetermined time period;

summing the monitored amount of message data to identify a total amount of message data transmitted over the signalling channel during the predetermined time period;

comparing the summed total amount of message data with an amount of full frame data transmittable over the signalling channel during an equivalent time period to obtain a loading ratio for the communications link;

comparing the loading ratio with a threshold loading value to identify increases in loading indicative of a danger of an overload; and

relieving loading increases on the communications link following indication of the danger of an overload.

34. The method as in claim 33 wherein the step of relieving includes one or more of the following steps of:

spreading signal unit messages to other communications links;

discarding low priority signal unit messages; or

controlling flow of signal unit messages.

35. The method as in claim 33 wherein each signal unit includes a length indicator field containing a value related to the amount of message data being transmitted

by the signal unit, the step of monitoring comprising the step of reading the value in the length indicator field of each signal unit.

36. The method as in claim 35 wherein the step of summing comprises the step of adding together the read length indicator field values.

FIG. 1

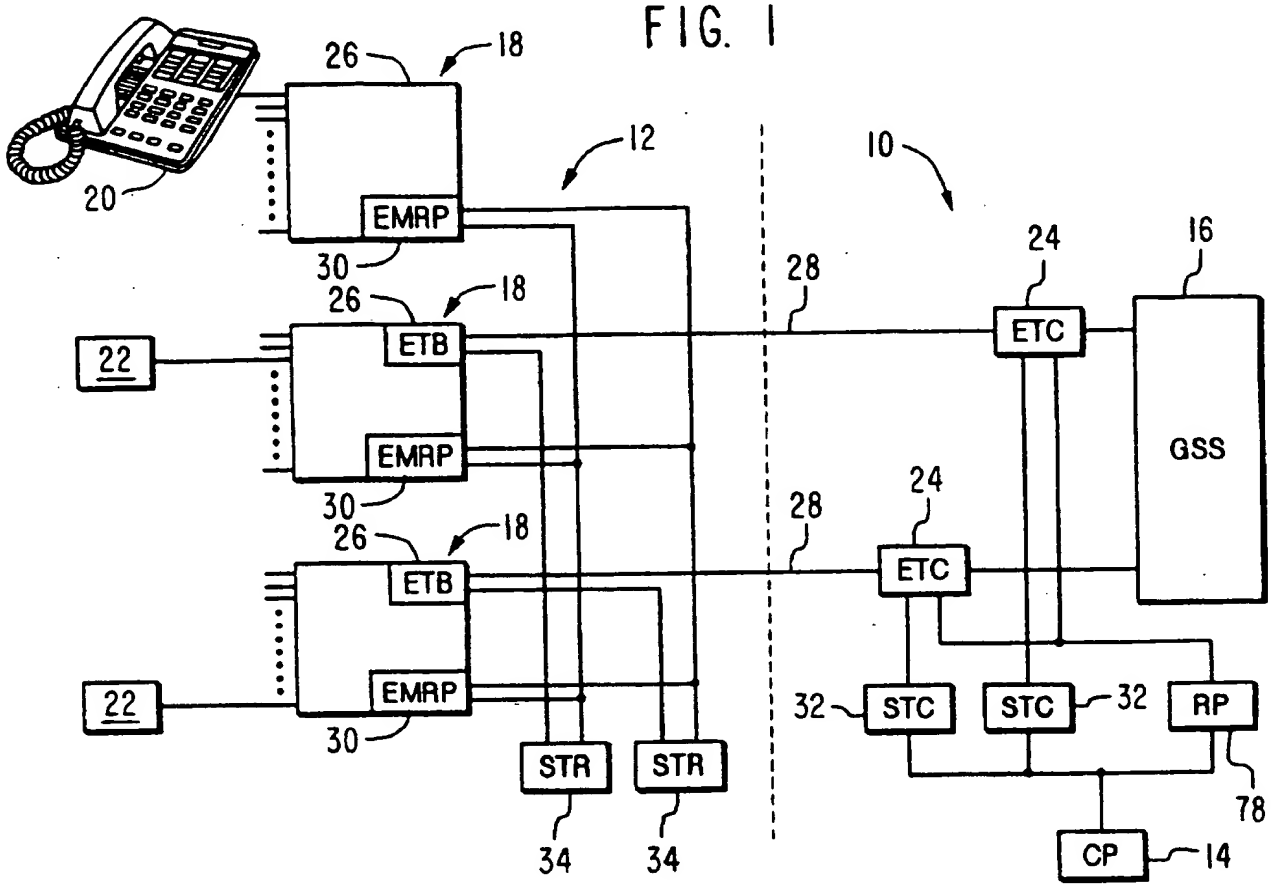

26
18
12
10
20
EMRP
30
24
16
28
ETB
22
ETC
GSS
STR
STR
32
STC
STC
32
RP
78
CP
14
34
34

FIG. 2

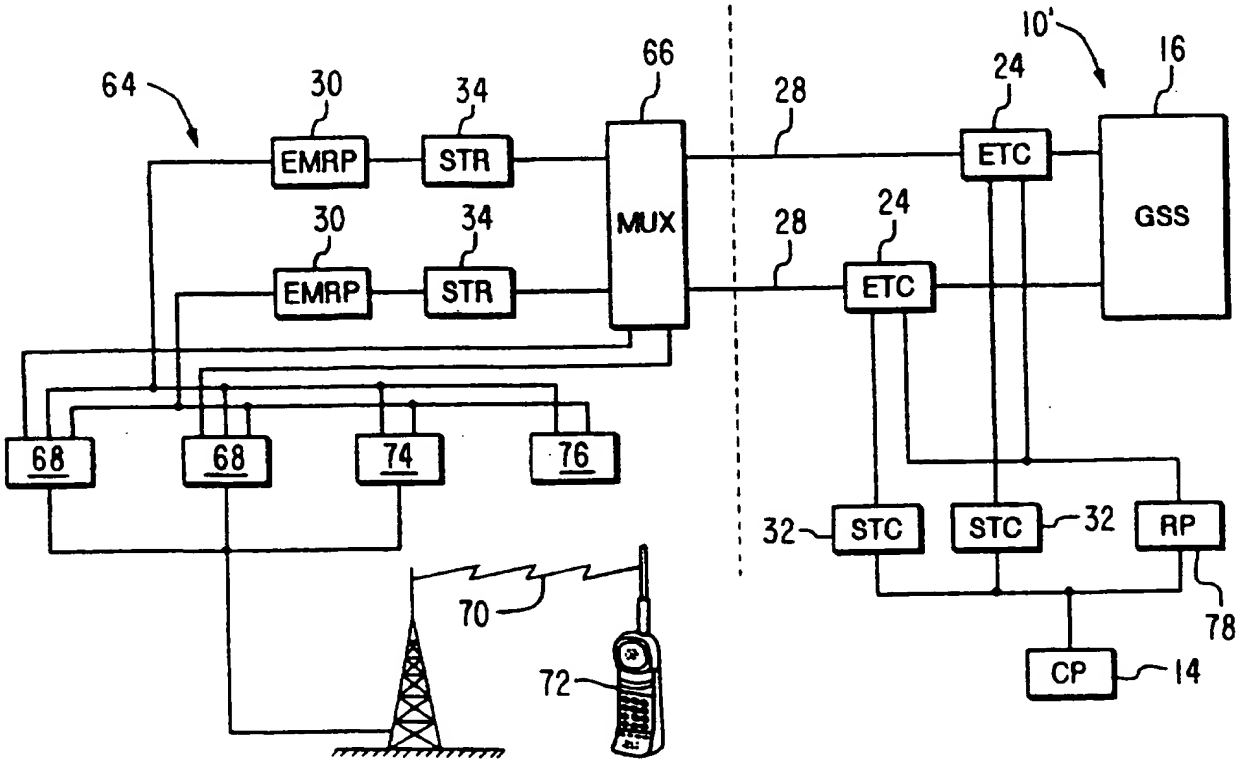

64
30
34
66
10'
16
24
28
EMRP
STR
MUX
ETC
GSS
68
68
74
76
70
72
32
STC
STC
32
RP
78
CP
14

FIG. 3

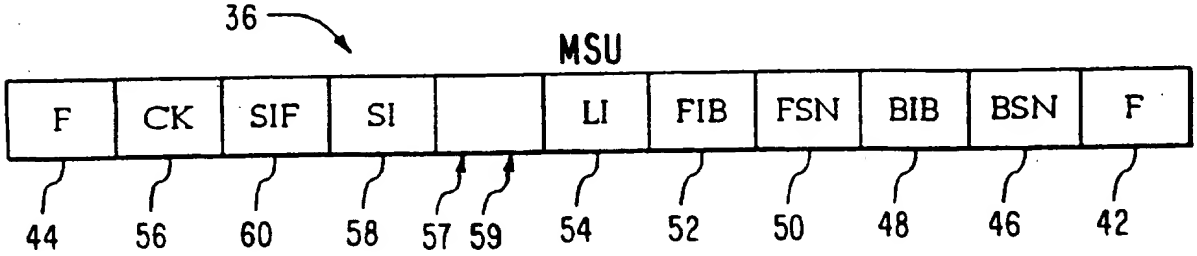


FIG. 4

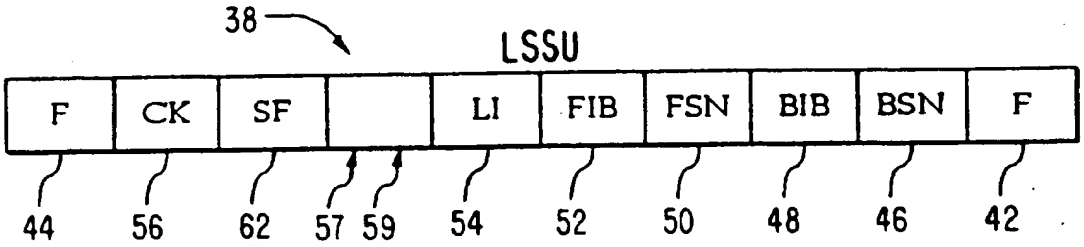


FIG. 5

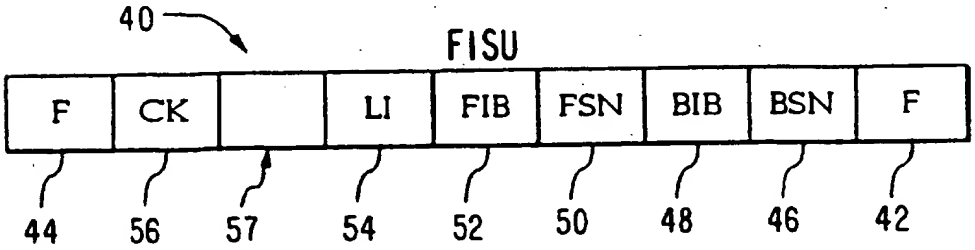
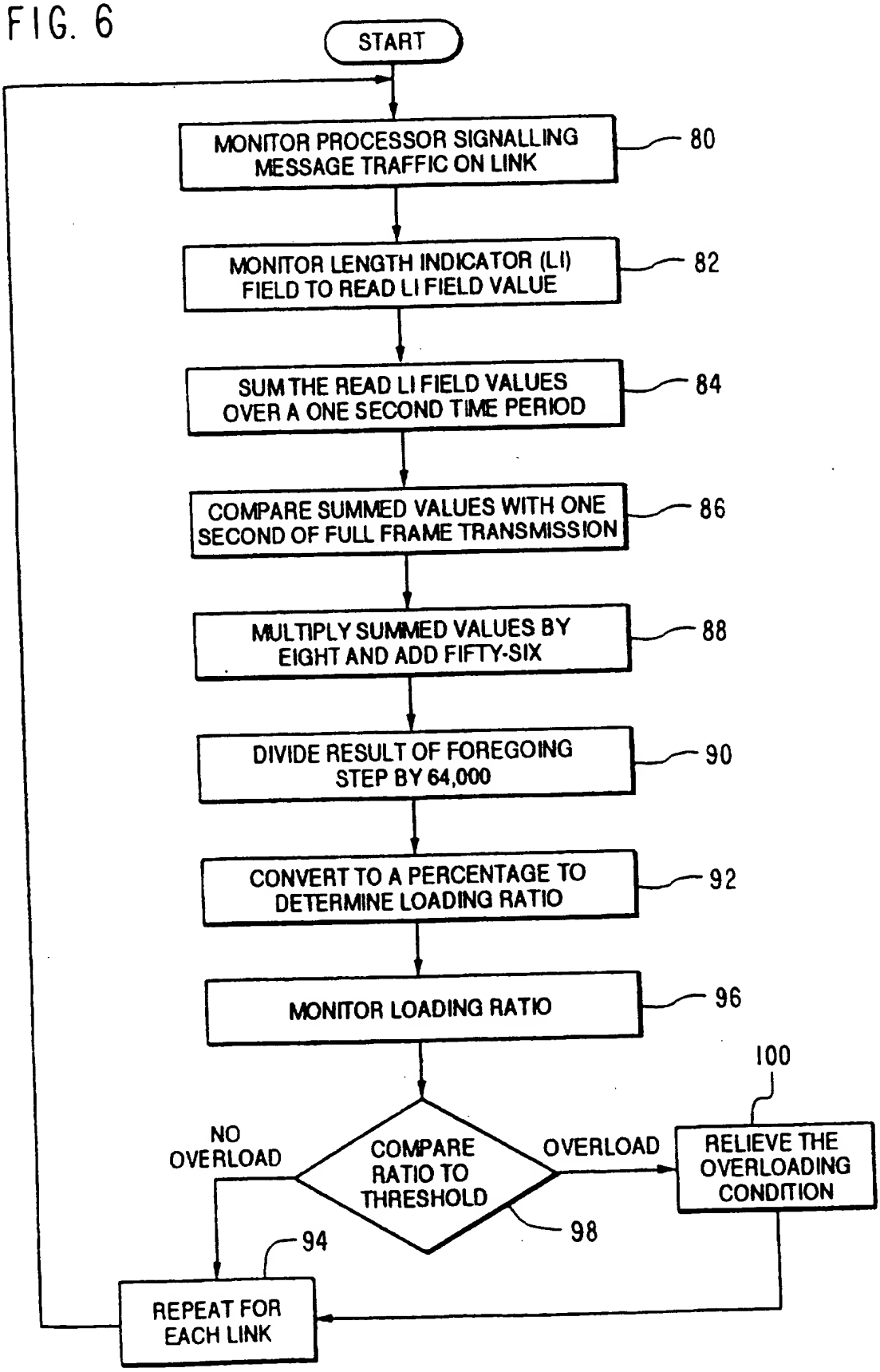


FIG. 6


START
MONITOR PROCESSOR SIGNALLING MESSAGE TRAFFIC ON LINK
80
MONITOR LENGTH INDICATOR (LI) FIELD TO READ LI FIELD VALUE
82
SUM THE READ LI FIELD VALUES OVER A ONE SECOND TIME PERIOD
84
COMPARE SUMMED VALUES WITH ONE SECOND OF FULL FRAME TRANSMISSION
86
MULTIPLY SUMMED VALUES BY EIGHT AND ADD FIFTY-SIX
88
DIVIDE RESULT OF FOREGOING STEP BY 64,000
90
CONVERT TO A PERCENTAGE TO DETERMINE LOADING RATIO
92
MONITOR LOADING RATIO
96
100
NO OVERLOAD
COMPARE RATIO TO THRESHOLD
OVERLOAD
RELIEVE THE OVERLOADING CONDITION
98
94
REPEAT FOR EACH LINK

INTERNATIONAL SEARCH REPORT

International application No.
PCT/SE 95/01509

A. CLASSIFICATION OF SUBJECT MATTER

IPC6: H04M 3/22, H04Q 1/30
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC6: H04M, H04Q

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

DIALOG 125, 340, 350, 351

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	EP 0621734 A2 (HEWLETT PACKARD COMPANY), 26 October 1994 (26.10.94), page 2, line 34 - line 56	1-36
	--	
X	IEEE JOURNAL ON SELECTED AREAS IN COMMUNICATION, Volume 12, No 3, April 1994, (New York), J. Zepf et al., "Congestion and flow control in signaling system no. 7-impacts of intelligent networks and new services,", page 501 - page 509, especially paragraph 1 and paragraph 2A	1-36
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[X] Further documents are listed in the continuation of Box C. [X] See patent family annex.

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"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
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"Y" document of particular relevance: the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
14 June 1996	17 -06- 1996
Name and mailing address of the ISA/ Swedish Patent Office Box 5055, S-102 42 STOCKHOLM Facsimile No. +46 8 666 02 86	Authorized officer Roland Landström Telephone No. +46 8 782 25 00

INTERNATIONAL SEARCH REPORT

International application No.
PCT/SE 95/01509

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	COMPUTER NEWORKS AND ISDN SYSTEMS, Volume 26, No 12, Sept 1994, (Amsterdam), Roch H. Glitho, "Signalling system number 7 network services part and X.25: A comparative study", page 1495 - page 1502, figure 2 --	1-36
A	GRINSEC "ELECTRONIC SWITCHING" 1983, ELSEVIER SCIENCE PUBLISHERS, AMSTERDAM(NL), page 411, line 14 - page 415, line 30 --	1-36
A	US 4484326 A (JONATHAN S. TURNER), 20 November 1984 (20.11.84), column 1, line 36 - column 3, line 47, abstract --	1-36

INTERNATIONAL SEARCH REPORT

Information on patent family members

01/04/96

International application No.
PCT/SE 95/01509

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
EP-A2- 0621734	26/10/94	NONE	
US-A- 4484326	20/11/84	CA-A- 1208749	29/07/86
		EP-A,A- 0108554	16/05/84
		EP-A,A- 0124591	14/11/84
		JP-B- 2023109	22/05/90
		JP-T- 59501851	01/11/84
		WO-A,A- 8401869	10/05/84